How Groundwater Withdrawal Rates and Locations Affect Impacts to Virginia's Coastal Plain Aquifers

Jason Early, P.G. – Consulting Hydrogeologist, LLC

Eastern Virginia Groundwater Advisory Committee
Workgroup #2B – Trading

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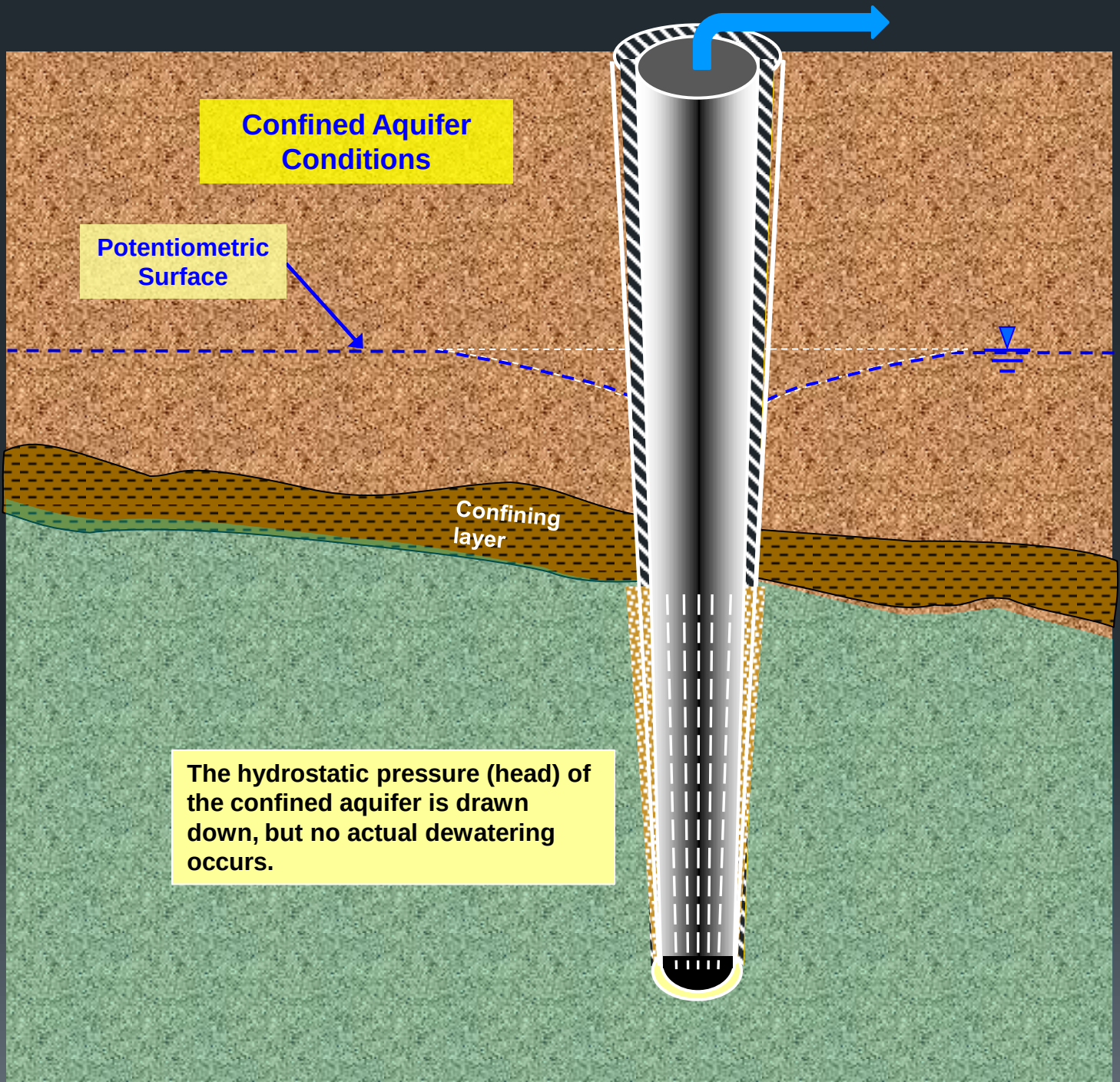
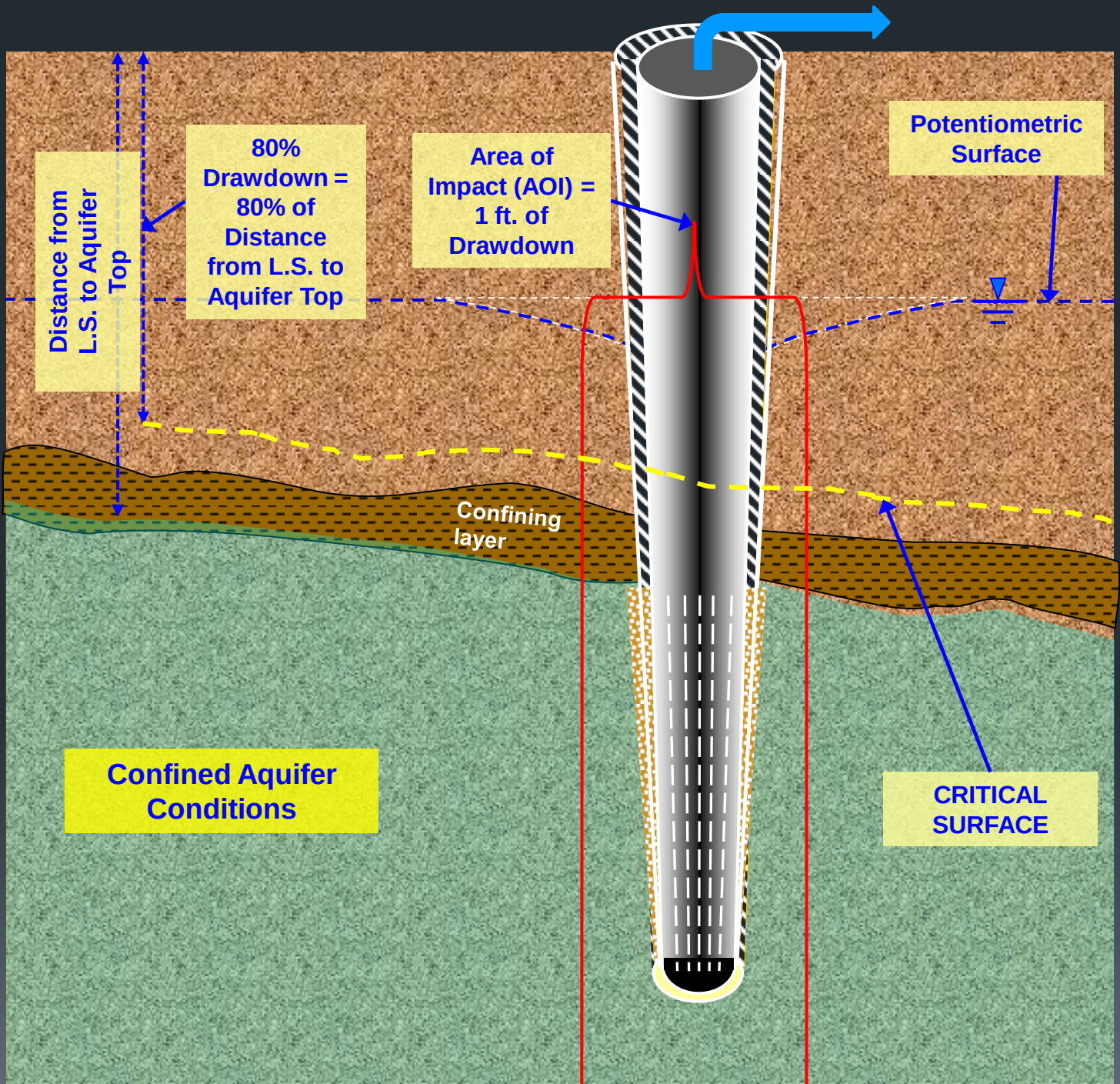
DEQ's Groundwater Model: VAHydroGW

- Developed by US Geological Survey in 2009
- Uses the industry standard MODFLOW code
- Covers entire VA Coastal Plain and adjacent areas in MD & NC
- Grid cells in most areas = 1 mi^2
- Model layers range from 35 to 100 ft thick
- Transient = allows for evaluation of changes over time
- DEQ uses model to predict impacts of new GW withdrawals compared to baseline
- Baseline = impacts of all existing GW withdrawals, at their **total permitted rates**


Confined Aquifer Conditions
Potentiometric Surface
Confining layer
The hydrostatic pressure (head) of the confined aquifer is drawn down, but no actual dewatering occurs.

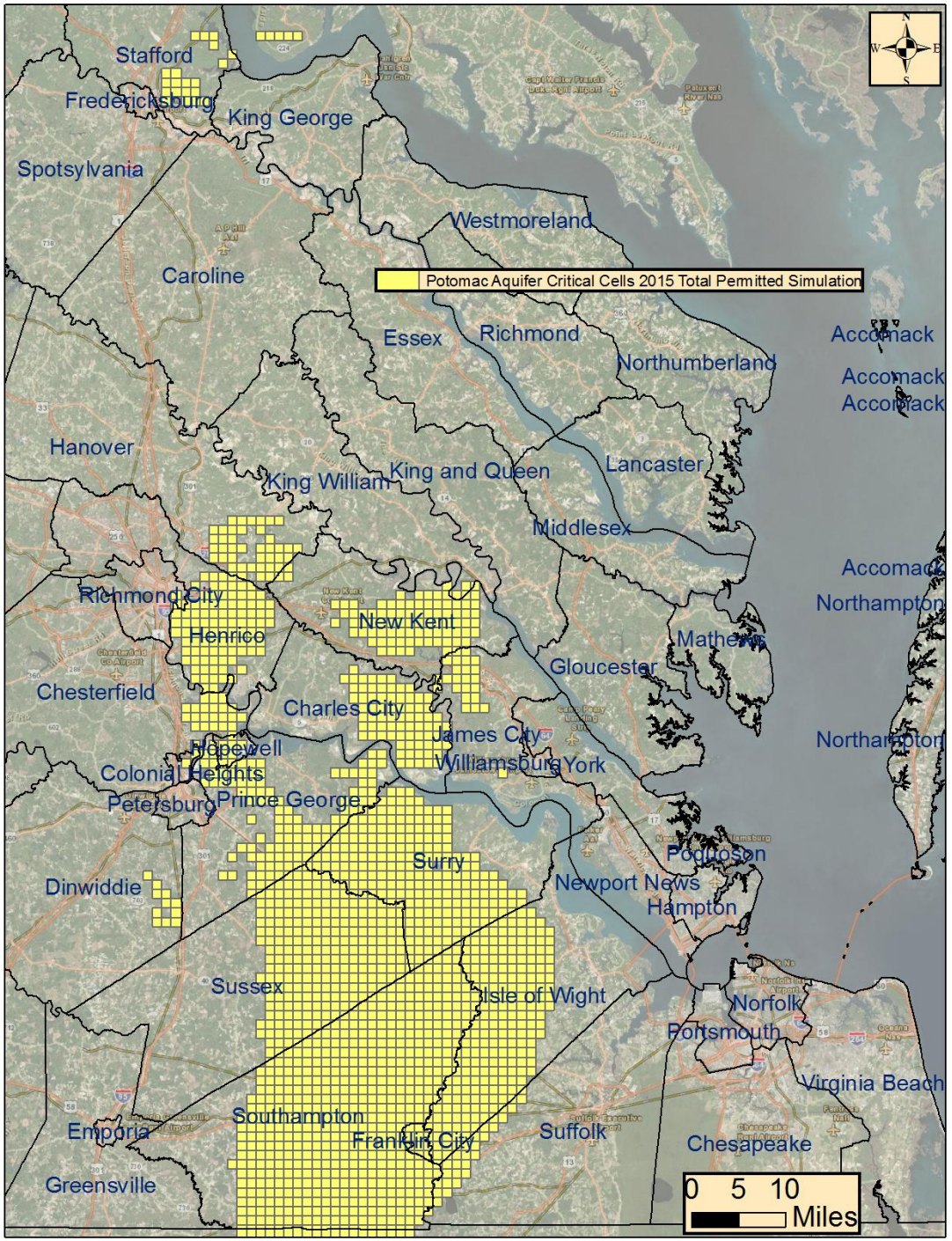

Distance from L.S. to Aquifer Top
80% Drawdown = 80% of Distance from L.S. to Aquifer Top
Area of Impact (AOI) = 1 ft. of Drawdown
Potentiometric Surface
Confining layer
Confined Aquifer Conditions
CRITICAL SURFACE

Evaluating Potential Impacts of GW Withdrawals

- Run model under baseline scenario (without withdrawal in question) – 50 years from present
- Run model with new or expanded withdrawal – 50 years from present
- Calculate Area of Impact (AOI) and Critical Cells

Baseline Scenario – 2015 Total Permitted Withdrawals

- Model predicts 1,746 critical cells in Potomac aquifer

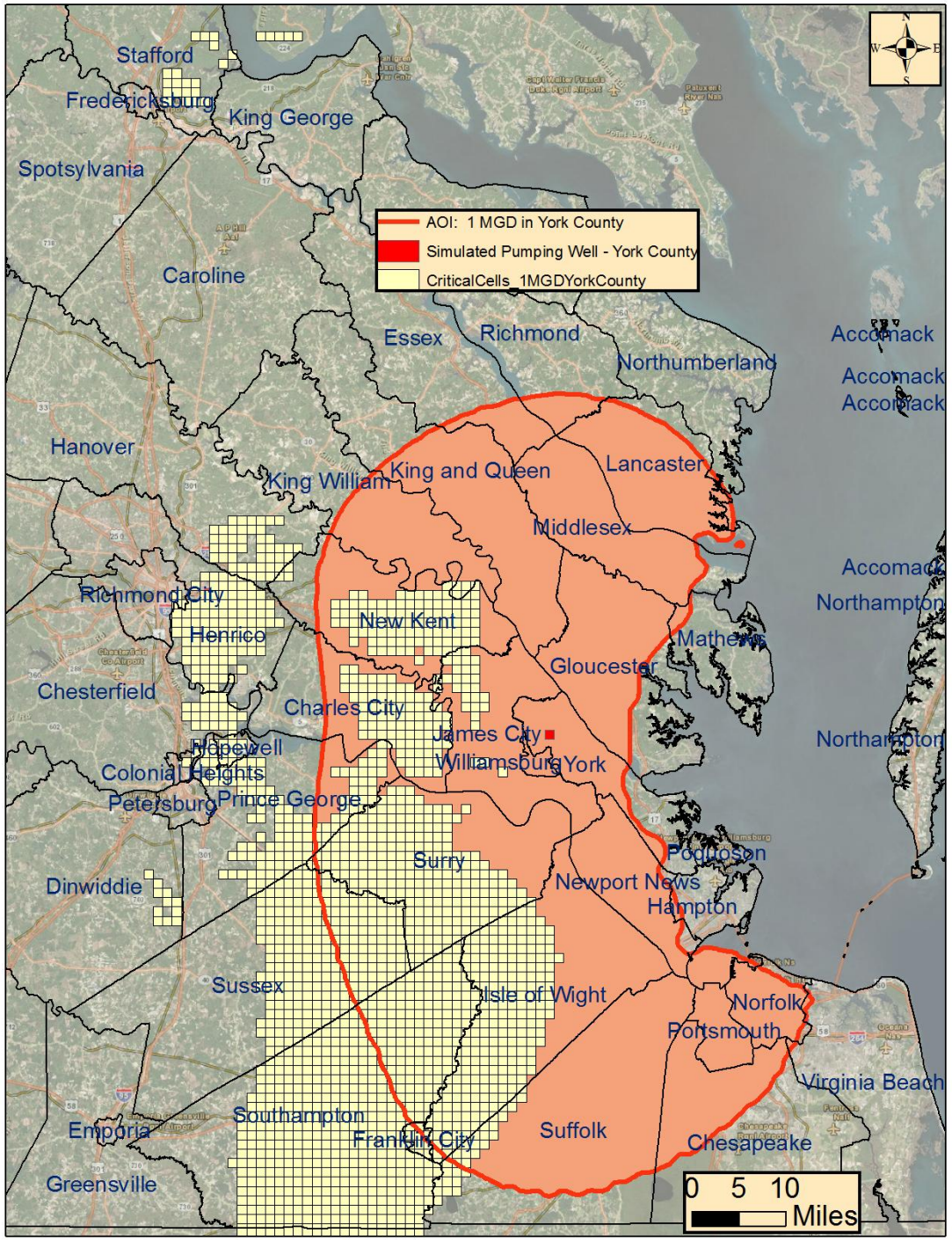


Hypothetical Withdrawal Simulations

- 1 MGD in York County
- 10 MGD in York County
- 1 MGD in New Kent County
- 10 MGD in New Kent County
- 1 MGD in Suffolk City
- 10 MGD in Suffolk City

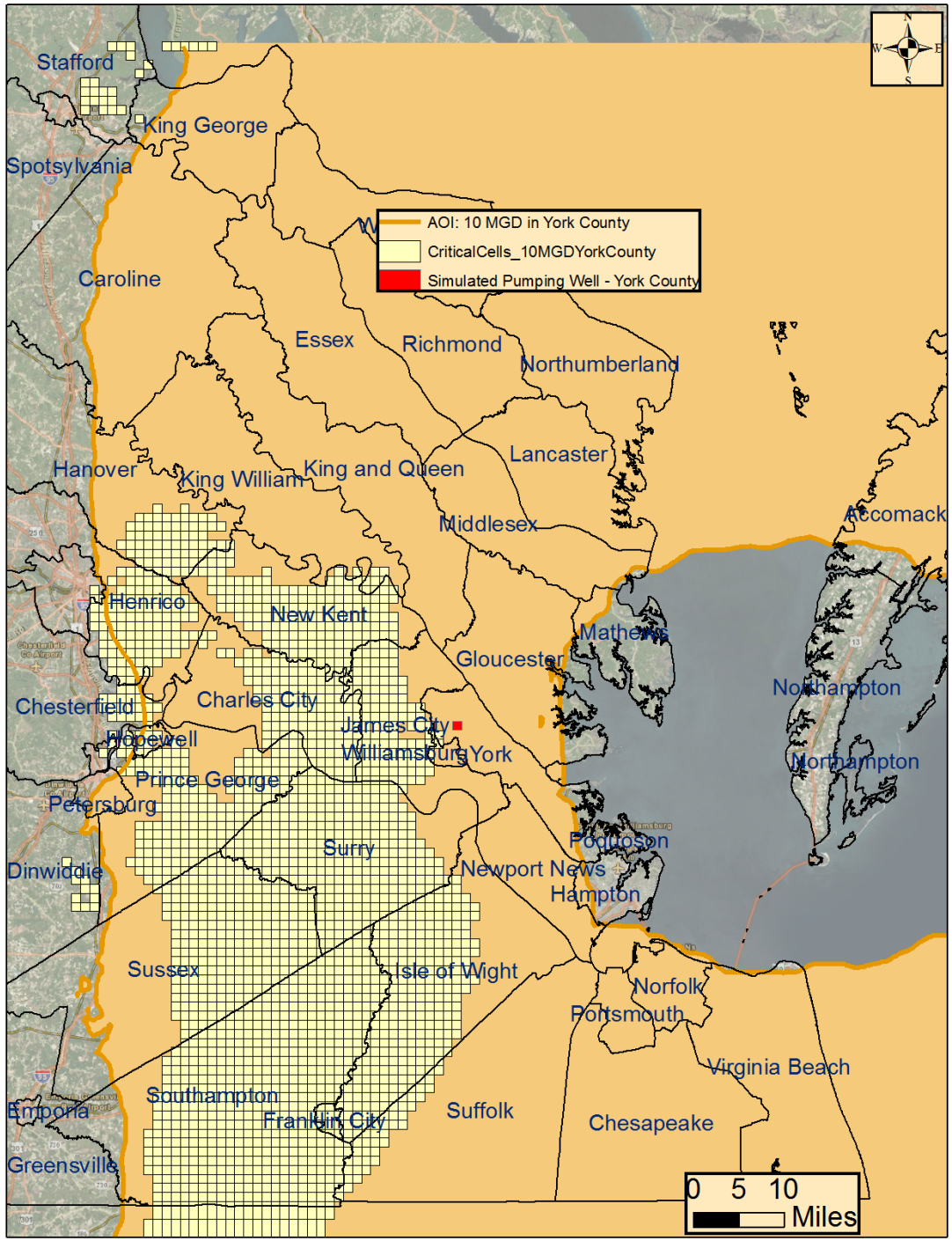
Hypothetical Withdrawal – 1 MGD in York County

- Model predicts 1,803 critical cells in Potomac aquifer:
  - 57 new critical cells created



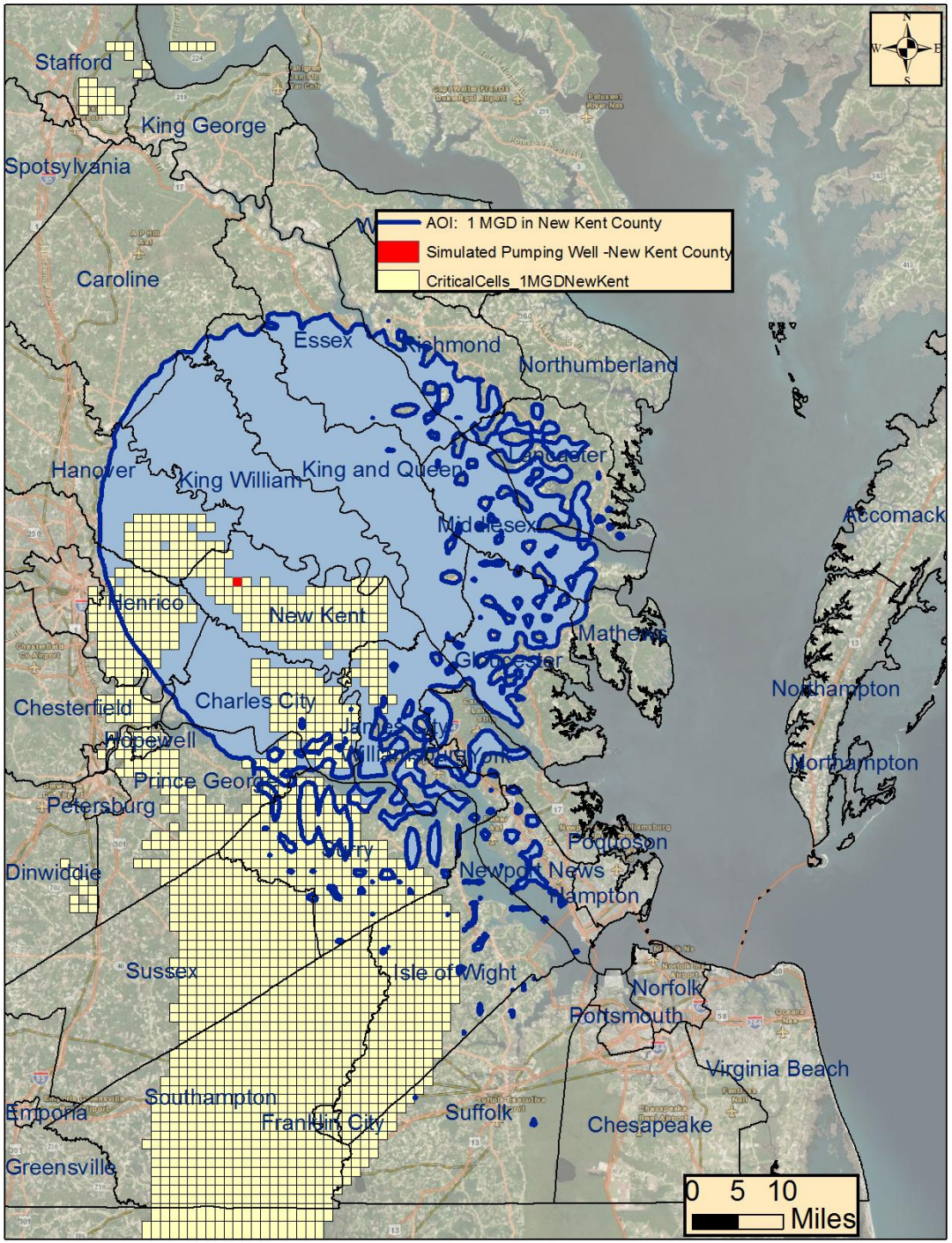
Hypothetical Withdrawal – 10 MGD in York County

- Model predicts 2,184 critical cells in Potomac aquifer:
  - 438 new critical cells created



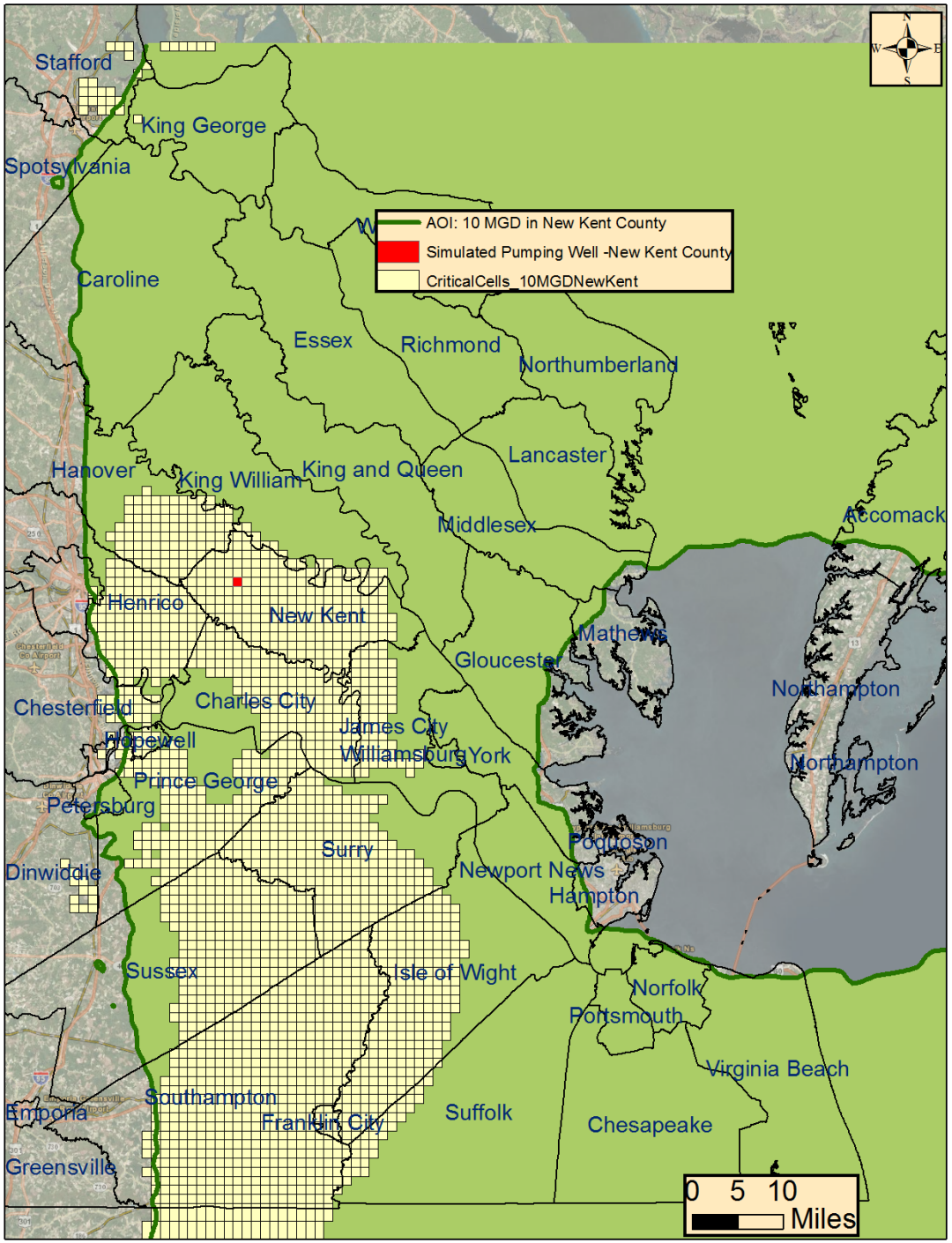
Hypothetical Withdrawal – 1 MGD in New Kent County

- Model predicts 1,832 critical cells in Potomac aquifer:
  - 86 new critical cells created



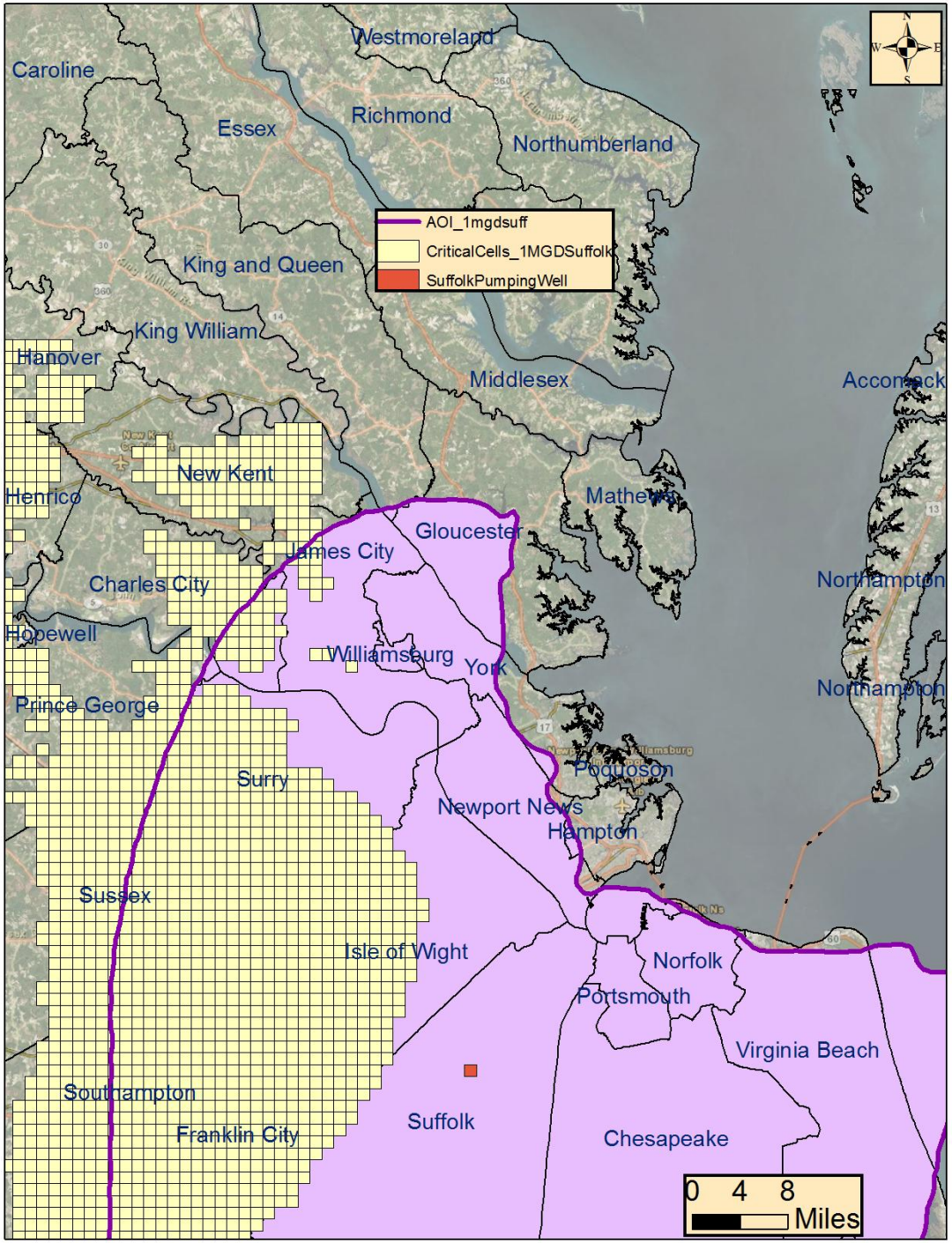
Hypothetical Withdrawal – 10 MGD in New Kent County

- Model predicts 2,194 critical cells in Potomac aquifer:
  - 448 new critical cells created



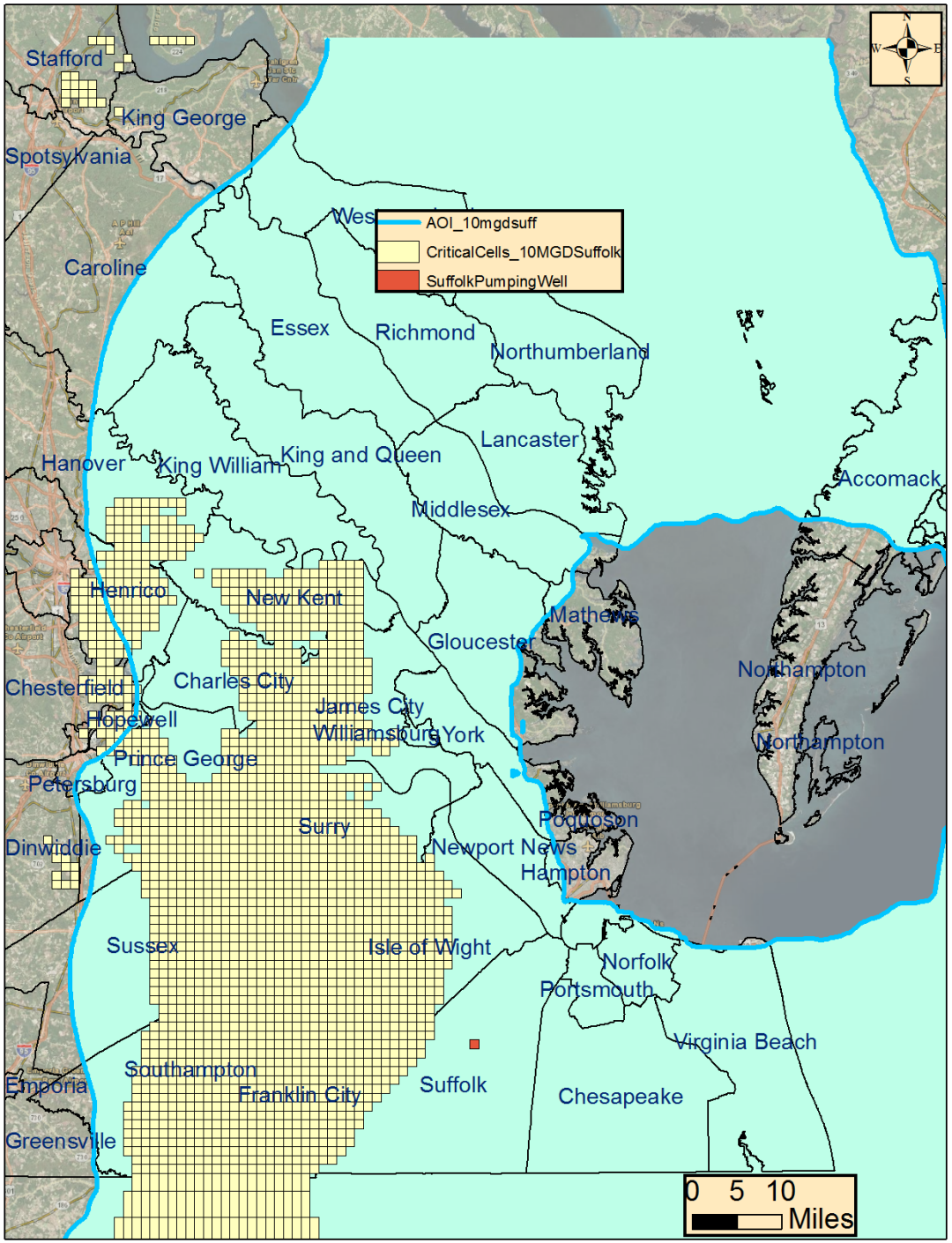
Hypothetical Withdrawal – 1 MGD in Suffolk City

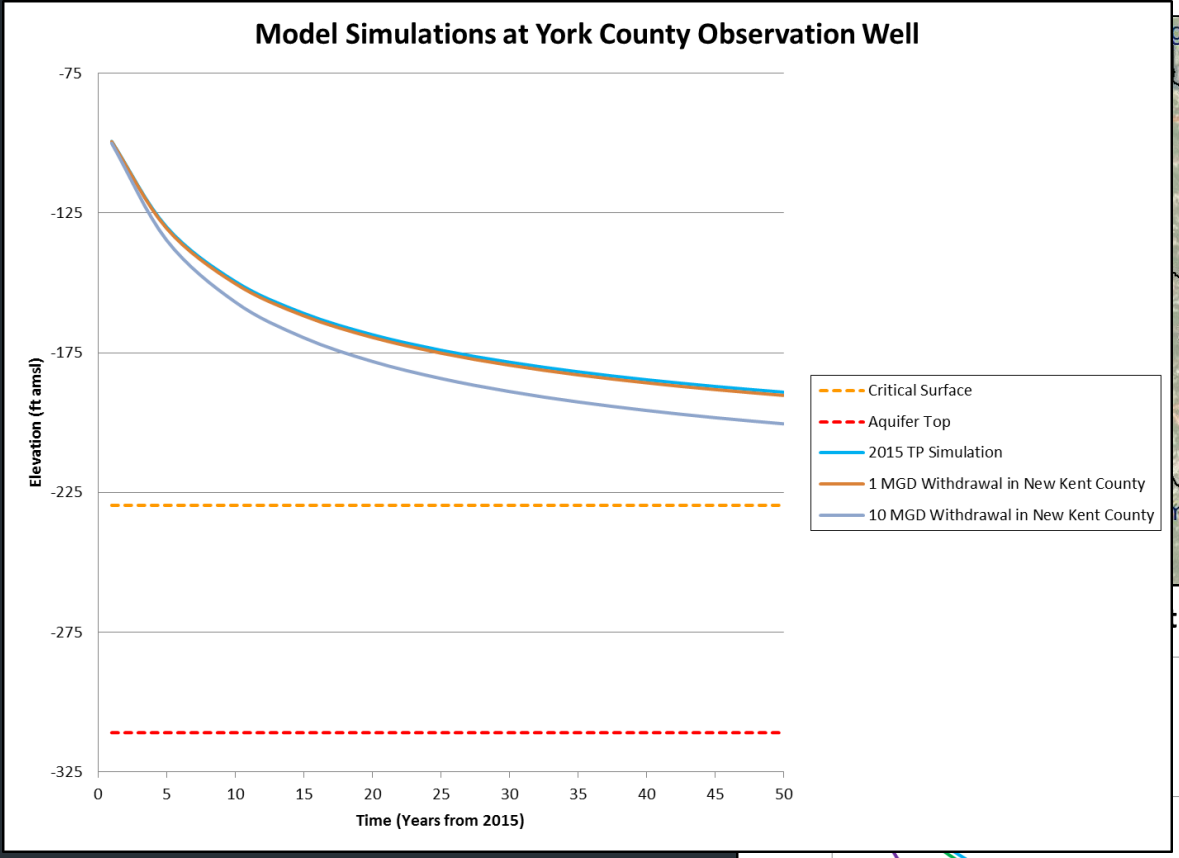
- Model predicts 1,784 critical cells in Potomac aquifer:
  - 38 new critical cells created

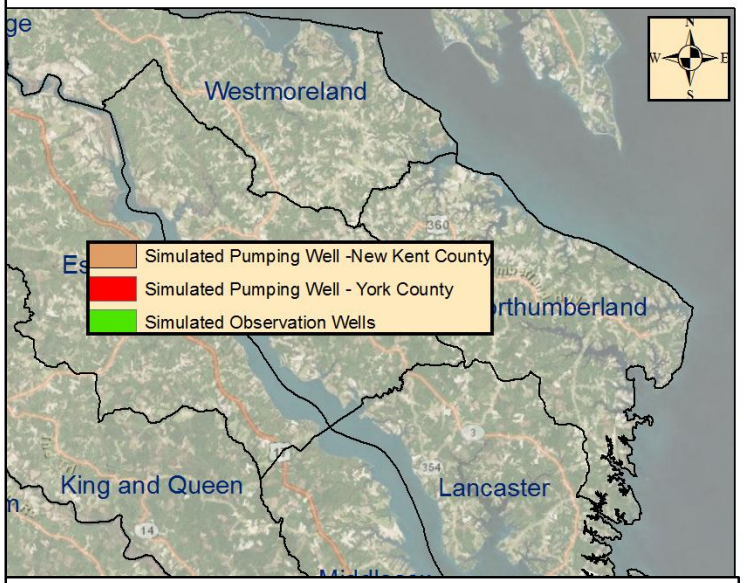


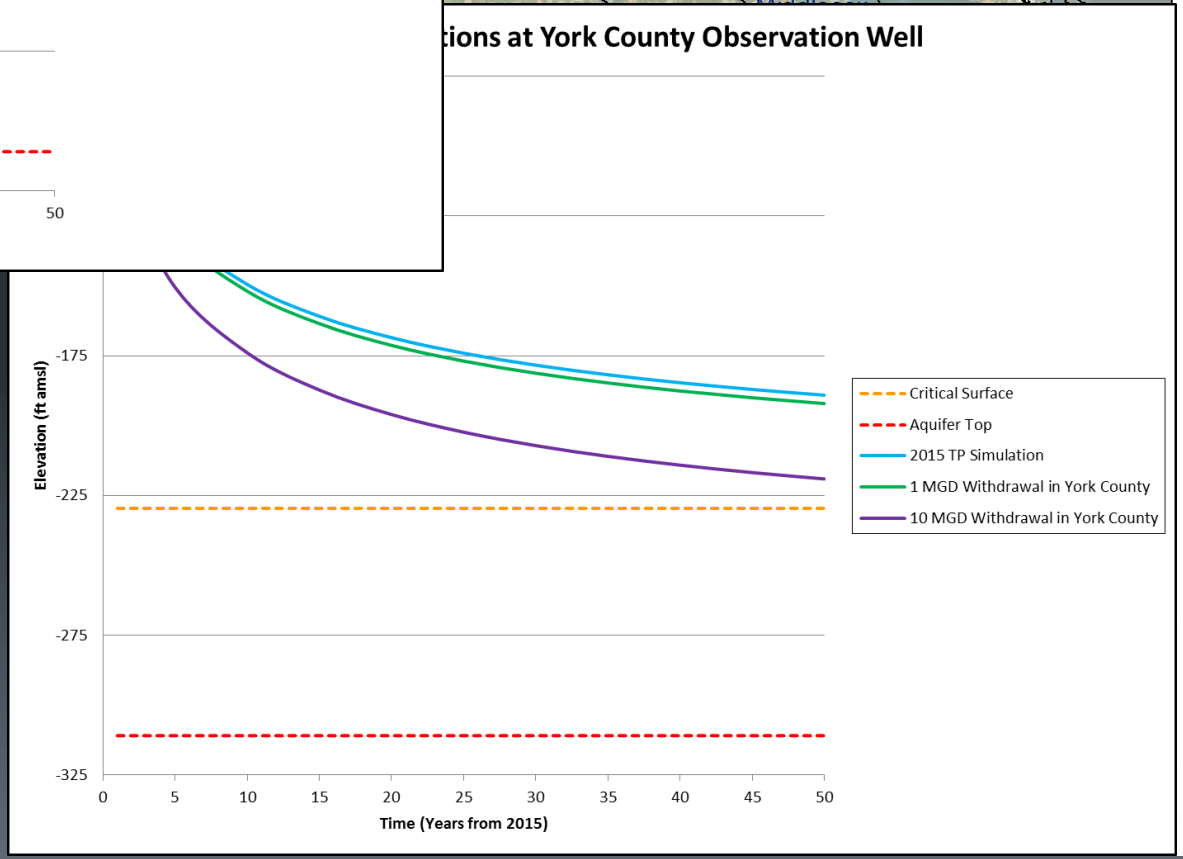
Hypothetical Withdrawal – 10 MGD in Suffolk City

- Model predicts 2,064 critical cells in Potomac aquifer:
  - 318 new critical cells created

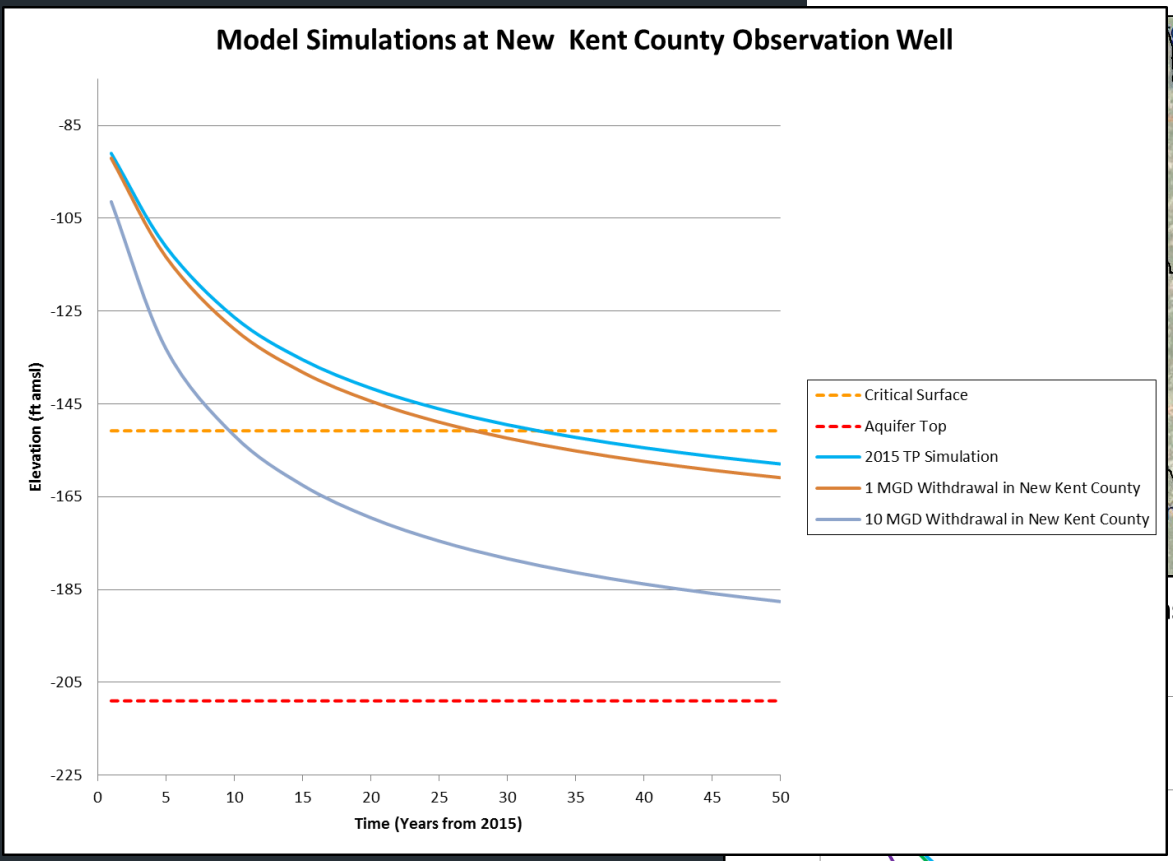


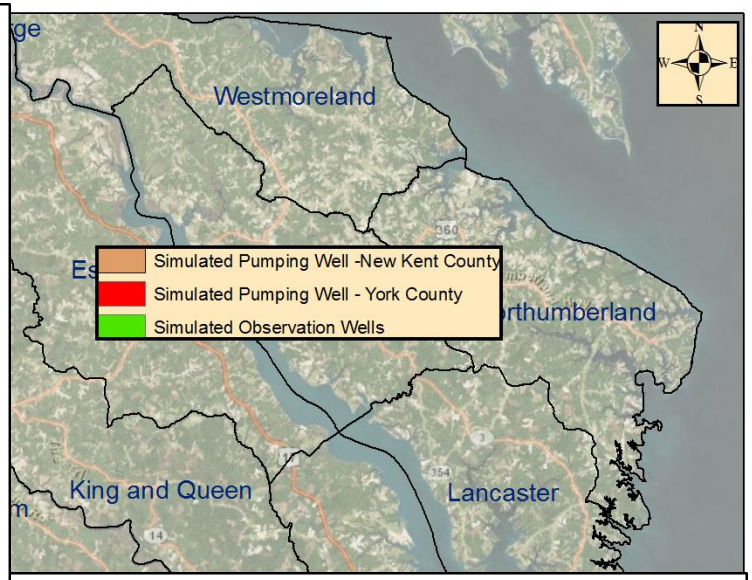


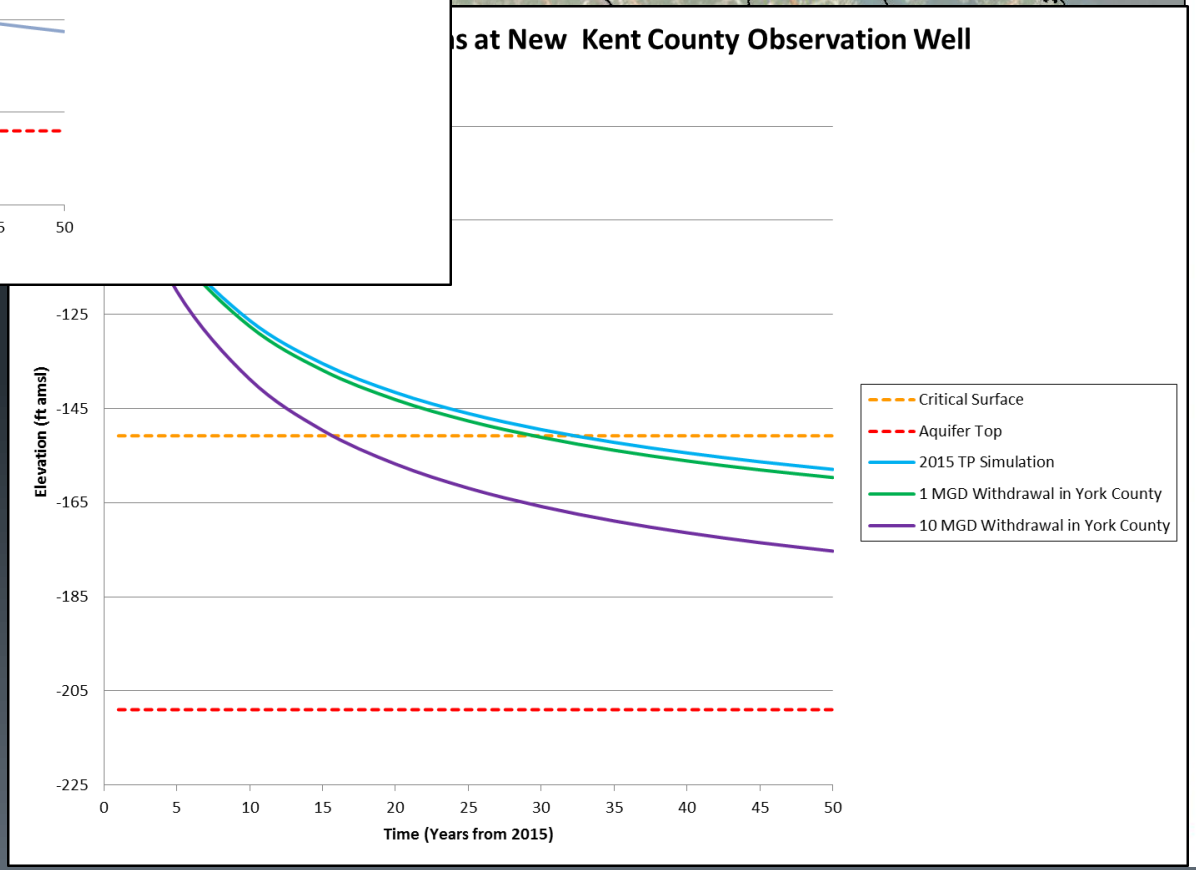




GW DECLINES OVER TIME AT SIMULATED YORK COUNTY OBSERVATION WELL

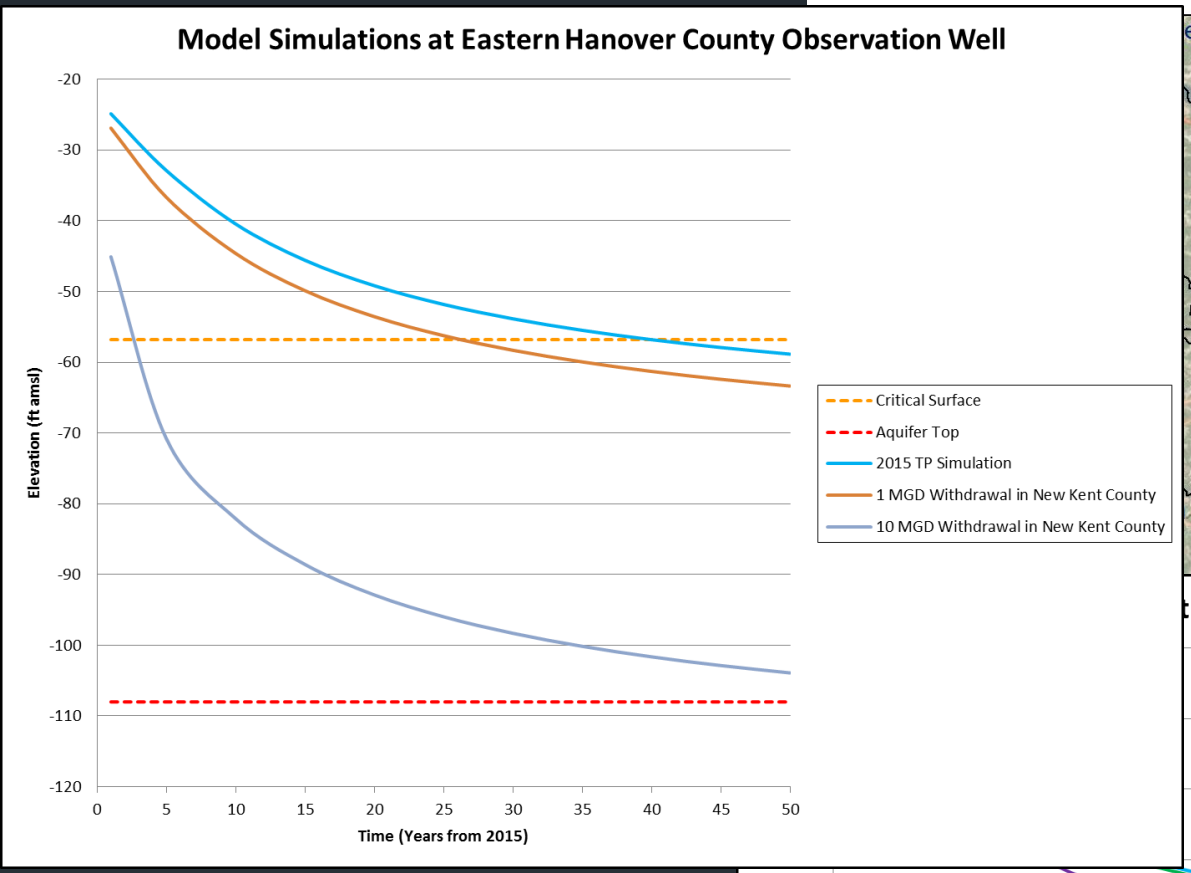


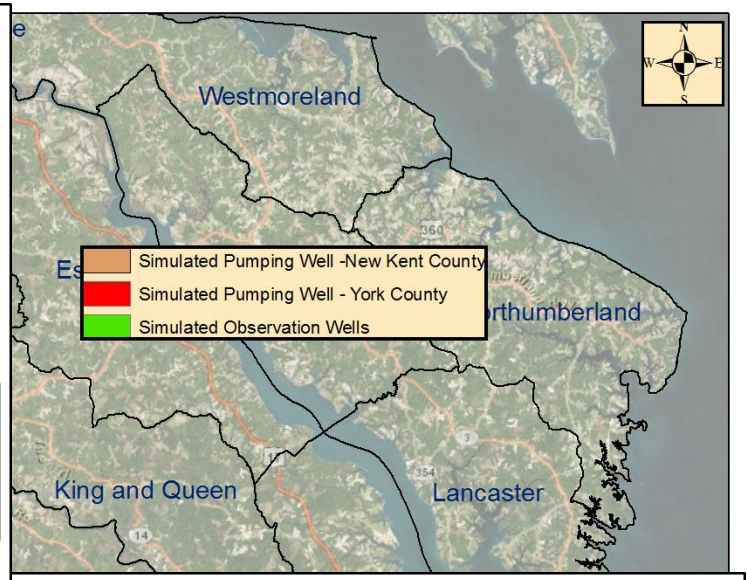


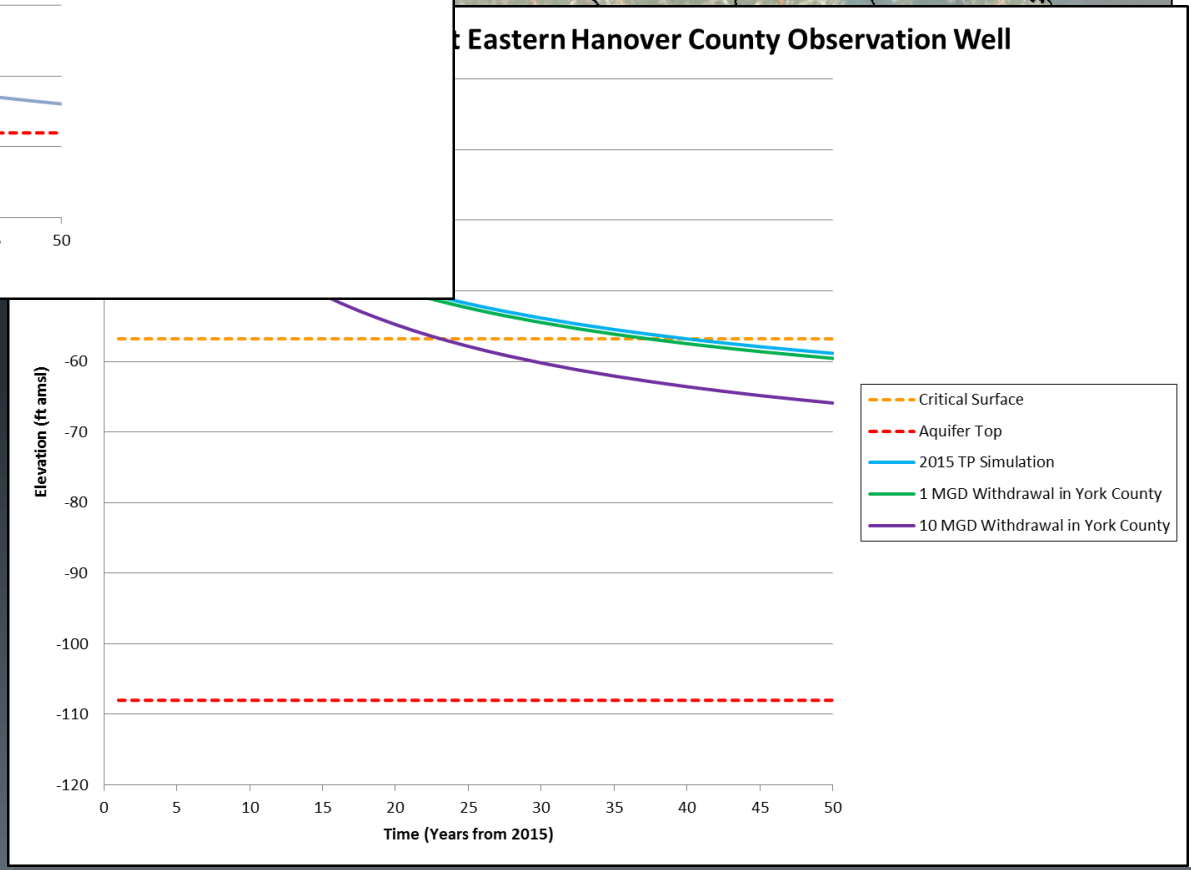


GW DECLINES OVER TIME AT SIMULATED NEW KENT COUNTY OBSERVATION WELL

GW DECLINES OVER TIME AT SIMULATED HANOVER COUNTY OBSERVATION WELL







What the Model Shows Us

- Effects of GW withdrawals depend on the magnitude of the withdrawals (pumping rates)
- Effects of GW withdrawals depend on the location of the withdrawals (where the pumping wells are located in the aquifer system)
- Aquifers generally reach a critical state more quickly along the western part of the Coastal Plain where the aquifers are thinner than in the eastern part of the Coastal Plain, where the aquifers are thicker

Questions?

Jason Early, PG – Consulting Hydrogeologist, LLC
Phone: (540) 809-5085
Email: ionactivity@yahoo.com